

so that the increase in consumer surplus because of the availability of this service (area abc in Figure 1) would be equal to one half of the revenue expected from its provider (area bcde in Figure 1).

Figure 2 illustrates the effect of entry (by the System A and the System B suppliers) in an “other Little LEO market”. Assuming linear demand curves and zero marginal cost, a reduction in the HHI from 6239 to 2784, and a market share of System A equal to its 28% share of capacity, the entry of System A and System B would result in an increase in consumer surplus (area abcde in Figure 2) equal to 2.36 times the revenue expected by Leo One USA (area defg in Figure 2).

Finally, Figure 3 illustrates the effect of entry (by System A and System B) into a perfectly competitive market, into which Little LEO suppliers essentially allocated whatever capacity would be left over after serving “Little LEO” markets. While Little LEO systems may make profits (or quasi-rents) in these markets, under these assumptions there would be no increase in consumer surplus from entry into these markets. Of course, to the extent that Little LEO sales in these markets were better characterized as sales of a differentiated product into “niche markets,” there could be significant consumer gains from Little LEO entry into these markets, of the same proportion of expected Leo One USA revenues in those markets as for new-service or “other Little LEO” markets.

VIII. INCUMBENT INCENTIVES IF SPECTRUM IS ALLOCATED THROUGH AN AUCTION

Incumbent firms with market power have anticompetitive incentives to request spectrum or to bid on spectrum if an auction is held. In this case, ORBCOMM (and potentially GE Starsys) has an incentive to acquire spectrum to block entry into markets in which it expects to operate or plans to enter eventually. Either or both could find it profitable to bid significant amounts (especially if ORBCOMM and GE Starsys act together or split the cost) even if they planned simply to warehouse

that capacity. Since total profits of all suppliers would fall with entry, the monopolist (or duopolists) stand to lose more than the entrant will gain, so that a monopolist (or duopolists acting together) will always outbid an entrant. Or, as phrased in the leading graduate industrial organization text²²:

Because competition destroys industry profits, an incumbent has more incentive to deter entry than an entrant has to enter. (Tirole, 1980, p.350)

This is particularly true in this situation because, since marginal costs are very low, entry could be very expensive to the incumbent(s). Thus, an unrestricted auction could be expected to result in maintenance of the current, noncompetitive market structure, and a waste of the spectrum.

On the other hand, it might be argued that restricting any auction to new entrants could reduce the revenue received by the government for a scarce publicly-owned resource. We thus turn to a discussion of the potential benefits and potential costs of restricting any auction to new entrants.

A. The Benefits from Restricting Participation in an Auction to New Entrants

Incumbent monopolists have incentives to outbid potential entrants for any scarce resources necessary to enter and compete. When they do so, this is referred to as “preemption.”

²² Jean Tirole, *The Theory of Industrial Organization*, The MIT Press, 1988.

Curtis and Lipsey (1979), Dasgupta and Stiglitz (1980), Gilbert and Newberry (1982) and Krishna (1993)²³ -- among others -- were instrumental in clarifying the intuition behind preemption. And the intuition is simple: the most an entrant can bid for a scarce resource (e.g., a necessary government license or an oil reserve) is the profit an entrant earns in a duopoly market. The scarce resource is worth more to an incumbent monopolist, since by winning the bid for the resource, the monopoly profit stream can be retained. Since (absent perfect collusion) monopoly profits exceed duopoly profits, monopoly profits also exceed the entrant's share of duopoly profits. As Lewis (1983) described the analysis:

[The] argument is simple and appealing. Suppose the market can accommodate one more firm. The leader can prevent entry by spending more than the potential entrant to acquire the input necessary for production. The value of the input to the entrant equals the expected present value stream of its profits. This will be determined by competition with the leader which may take several forms. However, unless the post-entry equilibrium is cooperative, the input will be worth more to the dominant firm. The reason is that the leader can at least utilize the input exactly as the entrant would have used it...but typically, the leader can improve on this by coordinating production [otherwise known as exercising market power]. (Lewis, p. 1092,)

23

See Curtis Eaton and Richard Lipsey, "The Theory of Market Preemption: The Persistence of Excess Capacity and Monopoly in Growing Spatial Markets," *Economica*, May 1979, pp. 149-58; Partha Dasgupta and Joseph Stiglitz, "Uncertainty, Industrial Structure, and the Speed of R&D," *Bell Journal of Economics*, Spring 1980, pp. 1-28; Richard Gilbert and David Newberry, "Preemptive Patenting and the Persistence of Monopoly," *American Economic Review*, June 1982, pp. 514-26; Tracy R. Lewis, "Preemption, Divestiture, and Forward Contracting in a Market Dominated by a Single Firm," *American Economic Review*, December 1983, pp. 1091-1101, and Kala Krishna, "Auctions With Endogenous Valuations: The Persistence of Monopoly Revisited," *American Economic Review*, March 1993, pp. 147-160.

Preemption may be either complete or partial. Under complete preemption, the monopolist is able profitably to acquire all alternative supply sources. Under partial preemption, the monopolist is only able profitably to acquire some of the alternative supply sources. Lewis showed that complete preemption of a scarce resource may not always be profitable, but that partial preemption is always profitable.²⁴ Both complete and partial preemption is bad -- economic welfare is reduced.²⁵

Thus, the economics literature on preemption establishes that complete preemption by a dominant firm of all alternatives for necessary scarce resources to challenge the dominant firm may be profitable, but even where complete preemption is not profitable, partial preemption will always be in the monopolist's economic interest.

B. Potential Effects of a Bidding Limitation on Auction Revenue

One should not assume that the government's revenues from any auction of the relevant spectrum would be lower if incumbent Little LEO suppliers were not allowed to bid, since adding

²⁴ Complete preemption is sometimes unprofitable because of a free-rider effect. The dominant firm bears all of the necessary output restriction to exercise market power. With many alternative sources of competition, complete preemption becomes unprofitable because with each increment of the scarce resource controlled by the dominant firm, the value of the remaining units of the resource to others increases. Increased control of the scarce resource by the dominant firm leads to an increase in market price, which in turn leads to an increased valuation of the remaining uncontrolled capacity by the fringe players. Lewis shows that it is always profitable for a dominant firm with market power to preempt the first alternative source of supply, but it may not be profitable (because of the free-rider effect described above) for the dominant firm to completely preempt all alternatives. (pp. 1095-6.) The major economic factors in determining the extent of preemption are the number of alternative sources, the capacity of the alternative sources relative to the installed capacity of the incumbent, and the market demand elasticity. The higher the market demand elasticity, the greater the cost (in terms of an output restriction) that the incumbent must bear to exercise market power.

²⁵ Ibid., p. 1099.

incumbents to the auction will not necessarily increase the number of bidders. Auction participation requires potential bidders to place at risk a significant investment. These expenditures include the costs of research to estimate demand, the costs of reaching partnering agreements, the costs of establishing detailed build-out plans, the costs of raising capital from variety of sources, and the cost of the legal and economic analysis necessary to receive regulatory approval.

Companies will not incur such up-front costs to participate in an effort that they are certain to lose, nor can sources of venture capital be expected for such efforts. Thus, if other participants believe that the incumbent monopolist will prevail in bidding (which is just what the preemption theory says will happen if everyone has full information), then alternative bidders will not bid. This is especially true in an English auction such as the FCC would be likely to run. In such an auction, each bidder can submit a sequence of bids, and knows what the prevailing high bid is at all times. There is no chance the monopolist will make a mistake and accidentally be outbid by somebody else.²⁶ Thus, auction revenues could fall if a single incumbent with market power were allowed to bid. All competitive bidders have strong incentives not to spend the money necessary to prepare a bid, knowing ultimately they will be outbid by someone who, because of market power, values the license more highly. The price of spectrum will be determined, in part, by the number of bidders. Adding incumbent Little LEO licensees as bidders will not increase the total number of bidders if other participants drop out.

²⁶

This possibility would exist in a sealed bid auction.

IX. AN AUCTION COULD BE PROBLEMATIC IN THIS INSTANCE, EVEN IF INCUMBENTS ARE EXCLUDED

Difficulties can arise with auctions when, as in the case with spectrum, the value of pieces are interdependent, and where (as a result) opportunistic holdout is possible. Thus, if an auction is held, any auction should not just exclude incumbents, but should also (1) allow bidding on units and groups, and (2) exclude those not planning on producing. This may be difficult. If so, a better approach may be to not have an auction.

A decision by the Commission to license the available spectrum rather than conduct an auction has ancillary implications. In particular, if the spectrum is assigned to second round applicants it seems unlikely that the new license holders will be allowed to redistribute the spectrum among each other through sales and exchanges after the award. As discussed below in Section XI, to allow such sales would not only allow windfall gains to applicants, but would also encourage rent-seeking applicants whose participation could either void the procompetitive effects of excluding incumbents from this round, or increase the cost to true entrants of building an efficiently sized and configured system. One implication of this observation is that it will be essential for the Commission to configure and assign this spectrum efficiently, since post-license adjustments through market mechanisms will be impossible or only occur at high transactions costs. We thus turn to the issue of how the spectrum should be organized before assignment.

X. THE SPECTRUM SHOULD BE REORGANIZED BEFORE THE FCC ASSIGNS LICENSES

As discussed above in Section VI, *Table 4: HHI Analysis* presents individual system capacities, market shares and the resulting HHI level under different assumptions as to licensing outcomes (the four rows in Table 4) and the role and viability of VITA and GE Starsys, respectively (the four columns in Table 4). Row 3 of Table 4 presents Leo One USA's estimate of the individual system capacity levels and capacity shares, and the resulting HHI level, if licenses are awarded for Systems 1, 2, and 3, as proposed in the Notice, while row 4 presents Leo One USA's estimate of the individual system capacity levels and capacity shares, and the resulting HHI level, if licenses are awarded for Systems A and B, as proposed by Leo One USA.

In contrasting the two proposals, four points stand out.

First, the Leo One USA proposal to create System A and System B results in a much more efficient use of the available spectrum. Total capacity is 3.13 "ORBCOMM equivalent units" versus 2.36 units under the NPRM proposal. As compared with existing licensed systems, there would be a 139% increase in capacity under the Leo One USA proposal, as opposed to an 80% increase in total capacity under the NPRM proposal. The Leo One USA proposal would result in a 33% increase in capacity over that available under the NPRM proposal. As in any market, a larger total capacity (holding constant the distribution of that total capacity among suppliers, as measured, for example, by the HHI) can be expected to result in lower costs (either financial costs or opportunity costs or both) to providers, greater output, lower prices and larger gains to consumers.

Second, the comparative advantage of Leo One USA's proposal improves if, as is likely, VITA operates in specialized not-for-profit markets and/or GE Starsys fails to launch its system.

Table 7: Percentage Increases in Total Capacity under NPRM Proposal and Leo One Proposal presents the percentage increase in total capacity under the four alternative scenarios with respect to VITA and GE Starsys. As Table 7 shows, the 80% increase in capacity when incumbents are

Table 7: Percentage Increases in Total Capacity Under NPRM Proposal and Little LEO Proposal

	ORBCOMM, GE Starsys and VITA each fully deploy	VITA operates in specialized not-for-profit market	GE Starsys fails to launch its system	Neither VITA nor GE Starsys participate in the market
1. Percent increase in total capacity from NPRM proposal over today's environment	80	85	99	106
2. Percent increase in total capacity from Leo One USA's proposal over today's environment	139	145	171	182
3. Percent increase in total capacity from Leo One USA's proposal over NPRM proposal	33	33	36	37
4. Difference in percent increase, Leo One USA proposal versus NPRM (row 2. - row 1.)	59	60	72	76

excluded under the NPRM proposal rises to 106% when neither VITA nor GE Starsys participate in the market, while the 139% increase in capacity when incumbents are excluded rises to 182% when neither VITA nor GE Starsys participate in the market. The advantage of the Leo One USA

proposal thus increases from a 59 percentage point increase in capacity to a 76 percentage point increase in capacity if neither VITA nor GE Starsys are expected to participate in the market

Third, under the Leo One USA proposal, the (greater) capacity is assigned so as to produce a more competitive market structure. Although the number of suppliers is smaller than in the NPRM proposal (five rather than six), capacity is more evenly distributed among those five suppliers. This more equal distribution more than offsets the effect on the HHI of a smaller number of suppliers²⁷, resulting in a significantly lower HHI under the Leo One USA proposal than under the NPRM.

²⁷ The HHI can be decomposed into a "number of suppliers" component and a "variance" component (See John E. Kwoka, Jr, "The Herfindahl Index in Theory and Practice," 30 *Antitrust Bulletin* 915-948 (Winter 1985)). Specifically:

$$HHI = 10,000 / N + 10,000 \text{ Var} / N$$

where N is the number of firms and Var is the square of the coefficient of variation in firm size. Thus the HHI under the NPRM proposal in Column 1 of Table 4 is:

$$\begin{aligned} HHI_{3,1} &= 10,000 / 6 + 10,000 (0.905) / 6 \\ &= 1667 + 1508 \\ &= 3175 \end{aligned}$$

while the HHI under the Leo One USA proposal in Column 1 is:

$$\begin{aligned} HHI_{4,1} &= 10,000/5 + 10,000 (0.3920)/5 \\ &= 2,000 + 784 \\ &= 2784 \end{aligned}$$

The 724 point fall in the variance component of the HHI (from 1508 to 784) when going from the NPRM to the Leo One USA proposal is greater than the 333 point increase in the numbers component of the HHI (from 1667 to 2000), resulting in a net fall in the HHI under the Leo One USA proposal by 391 points.

**Table 8: Reductions in HHI Under NPRM Proposal and Leo One USA Proposal
Under Alternative VITA and GE Starsys Scenarios**

	ORBCOMM. GE Starsys and VITA each fully deploy	VITA operates in specialized not-for-profit market	GE Starsys fails to launch its system	Neither VITA nor GE Starsys participate in the market
1. Decrease in the HHI under NPRM proposal from today's environment (and as % of current)	3064 = 49%	3472 = 51%	5149 = 57%	5961 = 60%
2. Decrease in the HHI under Leo One USA's proposal from today's environment (and as % of current)	3455 = 55%	3915 = 58%	5767 = 64%	6660 = 67%
3. Additional decrease in the HHI under Leo One USA's proposals compared to the NPRM proposal (and as % of 1.)	391 = 13%	443 = 13%	618 = 12%	699 = 12%

Fourth, as was the case for total capacity, the effect on the competitiveness of the market (as measured by the HHI) from excluding incumbent suppliers from the licensing (or auction) increases with the probability that VITA and/or GE Starsys will not be effective competitors in the relevant markets. As *Table 8: Reductions in HHI under NPRM Proposal and Leo One Proposal under Alternative VITA and GE Starsys Scenarios* shows, if VITA operates in specialized not-for-profit markets and GE Starsys fails to launch, the percentage decrease in the HHI achieved by excluding incumbent suppliers from the allocation (or auction) -- a proxy for the percentage decrease in prices

-- goes from a 49% decrease to a 60% decrease under the NPRM allocation, and from a 55% decrease to 67% decrease under the Leo One USA proposal.²⁸

As these calculations show, it is important not simply to count the number of suppliers in a market in determining the likely competitiveness of the market or the welfare of consumers. The effect on the prices paid by consumers from a larger number of suppliers can be swamped by the effects of larger total capacity, or by the effects of a more even distribution of that capacity or -- as in this case -- both.

X. PROCOMPETITIVE POST-LICENSING RESTRICTIONS

If reallocations of second-round-licensed spectrum through a market were costless, the Commission's initial assignments would have no effect on the ultimate distribution of that

²⁸

In an analysis corresponding to that in the preceding footnote, we can disaggregate the HHI under the NPRM and Leo One USA proposals for the case where neither VITA nor GE Starsys is in the market. Under these assumptions, the HHI under the NPRM proposal in Column 4 of Table 4 is:

$$\begin{aligned}\text{HHI}_{3,4} &= 10,000 / 4 + 10,000 (0.8348) / 4 \\ &= 2,500 + 2,087 \\ &= 4,587\end{aligned}$$

While the HHI under the Leo One USA proposal in Column 4 of Table 4 is:

$$\begin{aligned}\text{HHI}_{4,4} &= 10,000 / 3 + 10,000 (0.0021) / 3 \\ &= 3,333 + 7 \\ &= 3,340\end{aligned}$$

The fall in the variance component of the HHI is now 2080 points (from 2087 to 7). Even though the 833 point increase in the numbers component of the HHI (from 2500 to 3333) is also larger than in the scenario where both VITA and GE Starsys participate in the market, net fall in the HHI by 1,247 points under the Leo One USA proposal is much larger than in the scenario where both VITA and GE Starsys participate in the market.

spectrum.²⁹ If, as argued above, an auction by the Commission of these spectrum rights would lead to their being acquired directly by the incumbent monopolist or duopolists, then it will also be the case that, absent significant private transaction costs to reallocate that spectrum through the market, the incumbent monopolist or duopolist will rapidly acquire that spectrum through a post-licensing market transaction. In other words, if the Commission simply gives spectrum away with no restrictions on what the licensees do with that spectrum, we can expect a number of firms or individuals to attempt to induce the Commission to grant them spectrum which they would then turn around and sell to the highest bidder, which we would predict to be the incumbent monopolist.

Restrictions on post-licensing resale are thus essential to inducing actual entry and the resulting benefits to consumers. Those restrictions, however, must go beyond the normal restrictions under the antitrust laws. It is not enough, for example, for the Commission to prohibit the transfer of a second round license to a first round licensee if such a transfer would violate the antitrust laws or would be inconsistent with the *Guidelines*. Given the size of the fixed costs involved in a Little LEO entry, and the risks involved, it would hardly be surprising if one or more -- or even all -- second round licensees could make a convincing case that they were not, or were no longer, actual potential entrants. Such a showing would be particularly easy if the amount or quality of the spectrum assigned to that licensee were insufficient for entry by that licensee to be profitable. The

²⁹

This could be regarded as a partial version of the Coase theorem (Ronald H. Coase, "The Problem of Social Cost", *Journal of Law and Economics* 3: 1-44, 1960), which asserts that the optimal allocation of resources can always be achieved through market forces, irrespective of legal liability assignment, if information is perfect and transactions are costless.

sale of their capacity to the incumbent monopolist would then be acceptable under the *Guidelines*, since standard antitrust analysis would have to take the Commission's initial allocation as a *fait accompli*. Knowing this to be the case, such a limited restriction on post-licensing market transfer would not inhibit the attempt by potential licensees to obtain or acquire spectrum, of any quantity or in any configuration, however inefficient, which they could then resell to the incumbent monopolist. Potential licensees could even knowingly request that the FCC issue it spectrum that by itself cannot support a commercially viable operation, in the hopes of reselling the spectrum to an incumbent monopolist. Or, in even more anticompetitive scenario, potential licensees could request that the FCC issue it spectrum that could not support a commercially viable operation but which would be critical to the commercial viability of a true entrant, in the hopes of reselling that spectrum to a true entrant, thus imposing, in effect, a tax on entry.

The mere possibility of post-licensing resale can thus corrupt any initial mechanism for distributing spectrum, whether through an auction or through direct assignment. Since the Commission cannot require that every licensee commit to full-scale entry regardless of future conditions or events, it is thus critical that certain post-licensing resales, transfers or transactions between private parties be restricted.³⁰ Furthermore, the simple holding of unused spectrum by

³⁰

As should be clear, the potentially anticompetitive transactions are any purchases by the incumbent monopoly or dominant supplier (since this facilitates continued monopolization) and purchases by licensees that are viable potential entrants (since, like paying ransom, this just encourages inefficient competition for licenses and increases the cost of entry). On the other hand, neither monopolization nor holdup is affected by allowing the monopoly or dominant supplier to sell spectrum, or actual entrants to buy, sell or exchange spectrum.

licensees that do not enter imposes real social costs, including higher costs to consumers. Thus, unless the Commission wants to be in a position where it must buy back unused spectrum from licensees that do not undertake full-scale entry as Little LEO suppliers, it is important that licenses have a “use it or lose it” provision with a fairly tight time frame, under which unused spectrum reverts to the Commission.³¹ Such a provision is necessary unless spectrum is distributed through an auction to a competitive industry.

The alternative to this proposal is to regulate such transactions via antitrust. But the proposal here has a distinct advantage. Under antitrust, the sale of spectrum to a firm with market power would not generally be allowed if some other entity is willing to purchase the spectrum. Under antitrust, the market-based allocation of resources is generally preferred, except where one suspects the transaction is affected by market power. But returning unused spectrum to the Commission does not require the Commission to forego a market-based reallocation of the spectrum to another owner via an auction, if that is what the Commission wants to do. Moreover, returning unused spectrum to the Commission has a potentially important advantage over allowing the first-round spectrum-holder to resell it. The Commission, faced with the evidence that the initial allocation could not support a commercially viable operation, can redefine the spectrum rights, or combine the spectrum with another, as yet unallocated block, before the spectrum is reassigned (possibly by auction) to a

³¹ While such a provision should clearly apply to new licensees, application of “use it or lose it” provisions to suppliers who have already entered is undesirable, except possibly to an incumbent monopolist or dominant supplier. While such provisions may inhibit “warehousing” by a monopolist or by a firm or firms with market power, it may also induce inefficiently premature use and block the efficient expansion path over time.

new owner. In that case, the spectrum will be used more efficiently, and consumers will derive greater ultimate benefits, if the reorganization and reallocation of spectrum is done within the Commission rather than through a market.

/s/ Frederick R. Warren-Boulton

Frederick R. Warren-Boulton

SUBSCRIBED AND SWORN TO BEFORE ME this ____ day of December, 1996.

Notary Public

My Commission expires

TABLE 1

TABLE 1: MARKETS AND SUPPLIERS

TRACKING

			Satellite Systems								Terrestrial Voice & Data							Terrestrial Data								
			Leo One USA	Little LEO			Big Leo	Geo-synch																		
				Orbcomm	Starsys	VITA	Big Leo Systems	Inmarsat	AMSC (Skycell)	OmniTracs	Highwaymaster	VHF Radio Systems/WaterComm	Cellular	Broadband PCS	SMR	Geotek	NexTel	Ram Mobile Data	Ardis	CellNet	MetriCom	CDPD	Cellmetry	Pinpoint Comm.	Nexus Tele.	Narrowband PCS
Tracking	Coverage	Outages																								
Truck dispatch and monitoring	Global	< 5 minutes	I				m/h	H																		
		> 5 min. & < 30 min.	*				*	*																		
		> 30 min. & < 3 hr.	*	L	I		*	*	Hc	Hc																
	Nationwide: ubiquitous	< 5 minutes	I				m/h	H	H	H																
		> 5 min. & < 30 min.	*				*	*	*	*																
		> 30 min. & < 3 hr.	*	L	I		*	*	*	*	Hc		Lc	Lc			Mc	Mc	Mc							
	Nationwide: non-ubiquitous	< 5 minutes	I				m/h	H	H	H	H		L	L			M	M	M							
		> 5 min. & < 30 min.	*				*	*	*	*	*		*	*			*	*	*							
		> 30 min. & < 3 hr.	*	L	I		*	*	*	*	*		*	*	Lc	Mc	*	*	*	Lc	Lc	Mc		lc	lc	
	Urban / Pockets of Coverage	< 5 minutes	I				m/h	H	H	H	H		L	L	L	M	M	M	M	M	L	L	M		I	I
		> 5 min. & < 30 min.	*				*	*	*	*	*		*	*	*	*	*	*	*	*	*	*	*	*	*	*
		> 30 min. & < 3 hr.	*	L	I		*	*	*	*	*		*	*	*	*	*	*	*	*	*	*	*	*	*	*
Maritime - commercial shipping	Global	< 5 minutes	I				m/h	H																		
		> 5 min. & < 30 min.	*				*	*																		
		> 30 min. & < 3 hr.	*	L	I		*	*	Hc	Hc		Mc														
	Nationwide: Coastal & Waterways	< 5 minutes	I				m/h	H	H	H		M														
		> 5 min. & < 30 min.	*				*	*	*	*		*														
		> 30 min. & < 3 hr.	*	L	I		*	*	*	*		*														
Maritime - recreational	Global	< 5 minutes	I				m/h	H																		
		> 5 min. & < 30 min.	*				*	*																		
		> 30 min. & < 3 hr.	*	L	I		*	*	Hc	Hc		Mc														
	Nationwide: Coastal & Waterways	< 5 minutes	I				m/h	H	H	H		M														
		> 5 min. & < 30 min.	*				*	*	*	*		*														
		> 30 min. & < 3 hr.	*	L	I		*	*	*	*		*														
Tracking - standard containers	Global	< 5 minutes	I				m/h	H																		
		> 5 min. & < 30 min.	*				*	*																		
		> 30 min. & < 3 hr.	*	L	I		*	*	Hc	Hc																
	Nationwide: ubiquitous	< 5 minutes	I				m/h	H	H	H																
		> 5 min. & < 30 min.	*				*	*	*	*																
		> 30 min. & < 3 hr.	*	L	I		*	*	*	*	Hc		Lc	Lc			Mc	Mc	Mc							
	Nationwide: non-ubiquitous	< 5 minutes	I				m/h	H	H	H	H		L	L			M	M	M							
		> 5 min. & < 30 min.	*				*	*	*	*	*		*	*			*	*	*							
		> 30 min. & < 3 hr.	*	L	I		*	*	*	*	*		*	*	Lc	Mc	*	*	*	Lc	Lc	Mc		lc	lc	
	Urban / Pockets of Coverage	< 5 minutes	I				m/h	H	H	H	H		L	L	L	M	M	M	M	L	L	M		I	I	
		> 5 min. & < 30 min.	*				*	*	*	*	*		*	*	*	*	*	*	*	*	*	*	*	*	*	*
		> 30 min. & < 3 hr.	*	L	I		*	*	*	*	*		*	*	*	*	*	*	*	*	*	*	*	*	*	*

TABLE 1: MARKETS AND SUPPLIERS

TRACKING

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Tracking	Coverage	Outages																								
Tracking - Refrigerated & hazardous material containers	Global	< 2 minutes	I					m/h	H																	
		> 2 min. & < 30 min.	*					*	*																	
		> 30 min. & < 3 hr.	*	L	I			*	*	Hc	Hc															
	Nationwide: ubiquitous	< 2 minutes	I					m/h	H	H	H															
		> 2 min. & < 30 min.	*					*	*	*	*															
		> 30 min. & < 3 hr.	*	L	I			*	*	*	*	Hc		Lc	Lc			Mc	Mc	Mc						
	Nationwide: non-ubiquitous	< 2 minutes	I					m/h	H	H	H	H		L	L			M	M	M						
		> 2 min. & < 30 min.	*					*	*	*	*	*		*	*			*	*	*						
		> 30 min. & < 3 hr.	*	L	I			*	*	*	*	*		*	*	Lc	Mc	*	*	*	Lc	Lc	Mc		Ic	Ic
	Urban / Pockets of Coverage	< 2 minutes	I					m/h	H	H	H	H		L	L	L	M	M	M	M	L	L	M		I	I
		> 2 min. & < 30 min.	*					*	*	*	*	*		*	*	*	*	*	*	*	*	*	*	*	*	*
		> 30 min. & < 3 hr.	*	L	I			*	*	*	*	*		*	*	*	*	*	*	*	*	*	*	*	*	*

TABLE 1: MARKETS AND SUPPLIERS

MONITORING

Satellite Systems

Terrestrial Voice & Data

Terrestrial Data

Monitoring

			Satellite Systems										Terrestrial Voice & Data										Terrestrial Data																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
			Leo One USA	Little LEO			Big Leo Systems	Geo-synch																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																				

TABLE 1: MARKETS AND SUPPLIERS

MONITORING

Monitoring

			Satellite Systems								Terrestrial Voice & Data							Terrestrial Data								
			Leo One USA	Little LEO			Big Leo Systems	Geo-synch			Highwaymaster	VHF Radio Systems/WaterComm	Cellular	Broadband PCS	SMR	Geotek	NexTel	Ram Mobile Data	Ardis	CellNet	Mailroom	CDPD	Cellmarty	Pinpoint Comm.	Nexus Tele.	Narrowband PCS
Coverage	Outages																									
Irrigation system control points	Global	< 2 minutes	I				m/h	H																		
		> 2 min. & < 30 min.	*				*	*																		
		> 30 min. & < 3 hrs	*	L	I		*	*	Hc	Hc																
	Nationwide: ubiquitous	< 2 minutes	I				m/h	H	H	H																
		> 2 min. & < 30 min.	*				*	*	*	*																
		> 30 min. & < 3 hrs	*	L	I		*	*	*	*	Hc		Lc	Lc			Mc	Mc	Mc							
	Nationwide: non-ubiquitous	< 2 minutes	I				m/h	H	H	H	H		L	L			M	M	M							
		> 2 min. & < 30 min.	*				*	*	*	*	*		*	*			*	*	*							
		> 30 min. & < 3 hrs	*	L	I		*	*	*	*	*		*	*	Lc	Mc	*	*	*	Lc	Lc	Mc		lc	lc	
	Urban / Pockets of Coverage	< 2 minutes	I				m/h	H	H	H	H		L	L	L	M	M	M	M	L	L	M		I	I	
		> 2 min. & < 30 min.	*				*	*	*	*	*		*	*	*	*	*	*	*	*	*	*	*	*	*	*
		> 30 min. & < 3 hrs	*	L	I		*	*	*	*	*		*	*	*	*	*	*	*	*	*	*	*	*	*	*
Vending Machines	Global	< 30 minutes	I				m	H																		
		> 30 min. & < 3 hr.	*	L	I		*	*																		
		> 3 hours	*	*	*	I	*	*	Hc	Hc																
	Nationwide: ubiquitous	< 30 minutes	I				m	H	H	H																
		> 30 min. & < 3 hr.	*	L	I		*	*	*	*																
		> 3 hours	*	*	*	I	*	*	*	*	Hc		Lc	Lc			Mc	Mc	Mc							
	Nationwide: non-ubiquitous	< 30 minutes	I				m	H	H	H	H		L	L			M	M	M							
		> 30 min. & < 3 hr.	*	L	I		*	*	*	*	*		*	*			*	*	*							
		> 3 hours	*	*	*	I	*	*	*	*	*		*	*	Lc	Mc	*	*	*	Lc	Lc	Mc		lc	lc	
	Urban / Pockets of Coverage	< 30 minutes	I				m	H	H	H	H		L	L	L	M	M	M	M	L	L	M		I	I	
		> 30 min. & < 3 hr.	*	L	I		*	*	*	*	*		*	*	*	*	*	*	*	*	*	*	*	*	*	*
		> 3 hours	*	*	*	I	*	*	*	*	*		*	*	*	*	*	*	*	*	*	*	*	*	*	*

TABLE 1: MARKETS AND SUPPLIERS

MONITORING

Monitoring

			Satellite Systems								Terrestrial Voice & Data							Terrestrial Data								
			Leo One USA	Little LEO			Big Leo Systems	Inmarsat	Geo-synch		Highwaymaster	VHF Radio Systems/WaterComm	Cellular	Broadband PCS	SMR	Geotek	NexTel	Ram Mobile Data	Ardis	CellNet	MetriCom	CDPD	Cellmastery	Pinpoint Comm.	Nexus Tele.	Narrowband PCS
Security system monitoring	Global	< 2 minutes	I				mh	H																		
		> 2 min. & < 30 min.	*				*	*																		
		> 30 min. & < 3 hrs	*	L	I		*	*	Hc	Hc																
	Nationwide: ubiquitous	< 2 minutes	I				mh	H	H	H																
		> 2 min. & < 30 min.	*				*	*	*	*																
		> 30 min. & < 3 hrs	*	L	I		*	*	*	*	Hc		Lc	Lc			Mc	Mc	Mc							
	Nationwide: non-ubiquitous	< 2 minutes	I				mh	H	H	H	H		L	L			M	M	M							
		> 2 min. & < 30 min.	*				*	*	*	*	*		*	*			*	*	*							
		> 30 min. & < 3 hrs	*	L	I		*	*	*	*	*		*	*	Lc	Mc	*	*	*	Lc	Lc	Mc		lc		lc
	Urban / Pockets of Coverage	< 2 minutes	I				mh	H	H	H	H		L	L	L	M	M	M	M	L	L	M		I		I
		> 2 min. & < 30 min.	*				*	*	*	*	*		*	*	*	*	*	*	*	*	*	*	*	*	*	*
		> 30 min. & < 3 hrs	*	L	I		*	*	*	*	*		*	*	*	*	*	*	*	*	*	*	*	*	*	*

TABLE 1: MARKETS AND SUPPLIERS
EMERGENCY SERVICES

			Satellite Systems										Terrestrial Voice & Data							Terrestrial Data						
			Leo One USA	Little LEO			Big Leo Systems	Geo-synch			Highwaymaster	VHF Radio Systems/WaterComm	Cellular	Broadband PCS	SMR	Geotek	NexTel	Ram Mobile Data	Ardis	CellNet	Mailroom	CDPD	Cellmatics	Pinpoint Comm.	Nexus Tele.	Narrowband PCS
			Orbcomm	Staraya	VITA			Inmarsat	AMSC (Skycell)	Omnitrac																
Emergency Services	Coverage	Outages																								
Emergency Road Service Subscribers	Global	< 2 minutes	I				m/h	H																		
		> 2 min. & < 30 min.	*				*	*																		
		> 30 min.	*	L	I	I	*	*	Hc	Hc																
	Nationwide: ubiquitous	< 2 minutes	I				m/h	H	H	H																
		> 2 min. & < 30 min.	*				*	*	*	*																
		> 30 min.	*	L	I	I	*	*	*	*	Hc	Lc	Lc			Mc	Mc	Mc								
	Nationwide: non-ubiquitous	< 2 minutes	I				m/h	H	H	H	H	L	L			M	M	M								
		> 2 min. & < 30 min.	*				*	*	*	*	*	*	*		*	*	*	*								
		> 30 min.	*	L	I	I	*	*	*	*	*	*	*	Lc	Mc	*	*	*	Lc	Lc	Mc		lc		lc	
	Urban / Pockets of Coverage	< 2 minutes	I				m/h	H	H	H	H	L	L	L	M	M	M	M	L	L	M		I		I	
		> 2 min. & < 30 min.	*				*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		*		*	
		> 30 min.	*	L	I	I	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		*		*	
New Vehicle Monitoring & Communications	Global	< 2 minutes	I				m/h	H																		
		> 2 min. & < 30 min.	*				*	*																		
		> 30 min.	*	L	I	I	*	*	Hc	Hc																
	Nationwide: ubiquitous	< 2 minutes	I				m/h	H	H	H																
		> 2 min. & < 30 min.	*				*	*	*	*																
		> 30 min.	*	L	I	I	*	*	*	*	Hc	Lc	Lc			Mc	Mc	Mc								
	Nationwide: non-ubiquitous	< 2 minutes	I				m/h	H	H	H	H	L	L			M	M	M								
		> 2 min. & < 30 min.	*				*	*	*	*	*	*	*		*	*	*	*								
		> 30 min.	*	L	I	I	*	*	*	*	*	*	*	Lc	Mc	*	*	*	Lc	Lc	Mc		lc		lc	
	Urban / Pockets of Coverage	< 2 minutes	I				m/h	H	H	H	H	L	L	L	M	M	M	M	L	L	M		I		I	
		> 2 min. & < 30 min.	*				*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		*		*	
		> 30 min.	*	L	I	I	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		*		*	
Rental fleet monitoring and communications	Global	< 2 minutes	I				m/h	H																		
		> 2 min. & < 30 min.	*				*	*																		
		> 30 min.	*	L	I	I	*	*	Hc	Hc																
	Nationwide: ubiquitous	< 2 minutes	I				m/h	H	H	H																
		> 2 min. & < 30 min.	*				*	*	*	*																
		> 30 min.	*	L	I	I	*	*	*	*	Hc	Lc	Lc			Mc	Mc	Mc								
	Nationwide: non-ubiquitous	< 2 minutes	I				m/h	H	H	H	H	L	L			M	M	M								
		> 2 min. & < 30 min.	*				*	*	*	*	*	*	*		*	*	*	*								
		> 30 min.	*	L	I	I	*	*	*	*	*	*	*	Lc	Mc	*	*	*	Lc	Lc	Mc		lc		lc	
	Urban / Pockets of Coverage	< 2 minutes	I				m/h	H	H	H	H	L	L	L	M	M	M	M	L	L	M		I		I	
		> 2 min. & < 30 min.	*				*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		*		*	
		> 30 min.	*	L	I	I	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		*		*	

TABLE 1: MARKETS AND SUPPLIERS
EMERGENCY SERVICES

Emergency Services

			Satellite Systems								Terrestrial Voice & Data								Terrestrial Data							
			Leo One USA	Little LEO			Big Leo Systems	Inmarsat	Geo-synch			Highwaymaster	VHF Radio Systems/WaterComm	Cellular	Broadband PCS	SMR	Geotek	NexTel	Ram Mobile Data	Ardis	CellNet	MetriCom	CDPD	Cellmoby	Pinpoint Comm.	Nexus Tele.
Emergency Services	Coverage	Outages																								

TABLE 1: MARKETS AND SUPPLIERS

MESSAGING

			Satellite Systems							Terrestrial Voice & Data							Terrestrial Data									
			Leo One USA	Little LEO			Big Leo	Geo-synch																		
				Orbcomm	Starrys	VITA	Big Leo Systems	Inmarsat	AMSC (Skycell)	Onnitracs	Highwaymaster	VHF Radio Systems/WaterComm	Cellular	Broadband PCS	SMR	Geotek	NexTel	Ram Mobile Data	Ardis	CellNet	Metrom	CDPD	Cellmetry	Pinpoint Comm.	Nexus Tele.	Narrowband PCS
Messaging	Coverage	Outages																								
Messaging (paging and short e-mail)	Global	< 2 minutes	I				m/h	H																		
		> 2 min. & < 30 min.	*				*	*																		
		> 30 min.	*	L	I	I	*	*	Hc	Hc																
	Nationwide: ubiquitous	< 2 minutes	I				m/h	H	H	H																
		> 2 min. & < 30 min.	*				*	*	*	*																
		> 30 min.	*	L	I	I	*	*	*	*	Hc		Lc	Lc			Mc	Mc	Mc							
	Nationwide: non-ubiquitous	< 2 minutes	I				m/h	H	H	H	H		L	L			M	M	M							
		> 2 min. & < 30 min.	*				*	*	*	*	*		*	*		*	*	*	*	*						
		> 30 min.	*	L	I	I	*	*	*	*	*		*	*	Lc	Mc	*	*	*	Lc	Lc	Mc		lc		lc
	Urban / Pockets of Coverage	< 2 minutes	I				m/h	H	H	H	H		L	L	L	M	M	M	M	L	L	M		I		I
		> 2 min. & < 30 min.	*				*	*	*	*	*		*	*	*	*	*	*	*	*	*	*	*	*	*	*
		> 30 min.	*	L	I	I	*	*	*	*	*		*	*	*	*	*	*	*	*	*	*	*	*	*	*
Mobile workers (sales and service)	Global	< 2 minutes	I				m/h	H																		
		> 2 min. & < 30 min.	*				*	*																		
		> 30 min.	*	L	I	I	*	*	Hc	Hc																
	Nationwide: ubiquitous	< 2 minutes	I				m/h	H	H	H																
		> 2 min. & < 30 min.	*				*	*	*	*																
		> 30 min.	*	L	I	I	*	*	*	*	Hc		Lc	Lc			Mc	Mc	Mc							
	Nationwide: non-ubiquitous	< 2 minutes	I				m/h	H	H	H	H		L	L			M	M	M							
		> 2 min. & < 30 min.	*				*	*	*	*	*		*	*		*	*	*	*	*						
		> 30 min.	*	L	I	I	*	*	*	*	*		*	*	Lc	Mc	*	*	*	Lc	Lc	Mc		lc		lc
	Urban / Pockets of Coverage	< 2 minutes	I				m/h	H	H	H	H		L	L	L	M	M	M	M	L	L	M		I		I
		> 2 min. & < 30 min.	*				*	*	*	*	*		*	*	*	*	*	*	*	*	*	*	*	*	*	*
		> 30 min.	*	L	I	I	*	*	*	*	*		*	*	*	*	*	*	*	*	*	*	*	*	*	*
Information services (stock quotes, news, sports)	Global	< 2 minutes	I				m/h	H																		
		> 2 min. & < 30 min.	*				*	*																		
		> 30 min.	*	L	I	I	*	*	Hc	Hc																
	Nationwide: ubiquitous	< 2 minutes	I				m/h	H	H	H																
		> 2 min. & < 30 min.	*				*	*	*	*																
		> 30 min.	*	L	I	I	*	*	*	*	Hc		Lc	Lc			Mc	Mc	Mc							
	Nationwide: non-ubiquitous	< 2 minutes	I				m/h	H	H	H	H		L	L			M	M	M							
		> 2 min. & < 30 min.	*				*	*	*	*	*		*	*		*	*	*	*	*						
		> 30 min.	*	L	I	I	*	*	*	*	*		*	*	Lc	Mc	*	*	*	Lc	Lc	Mc		lc		lc
	Urban / Pockets of Coverage	< 2 minutes	I				m/h	H	H	H	H		L	L	L	M	M	M	M	L	L	M		I		I
		> 2 min. & < 30 min.	*				*	*	*	*	*		*	*	*	*	*	*	*	*	*	*	*	*	*	*
		> 30 min.	*	L	I	I	*	*	*	*	*		*	*	*	*	*	*	*	*	*	*	*	*	*	*

TABLE 1: MARKETS AND SUPPLIERS
TRANSACTION SERVICES

			Satellite Systems								Terrestrial Voice & Data							Terrestrial Data													
			Leo One USA	Little LEO			Big Leo	Geo-synch																							
				Orbcomm	Starlys	VITA	Big Leo Systems	Inmarsat	AMSC (Skycell)	Omniarea	Highwaymaster	VHF Radio Systems/WaterComm	Cellular	Broadband PCS	SMR	Geotek	NexTel	Ram Mobile Data	Ardis	CellNet	Metricom	CDPD	Cellmetry	Pinpoint Comm.	Nexus Tele.	Narrowband PCS					
Transaction Business Services			Coverage	Outages																											
DTH Television return path	Global	< 2 minutes	I				m/h	H																							
		> 2 min. & < 30 min.	*				*	*																							
		> 30 min.	*	L	I	I	*	*	Hc	Hc																					
	Nationwide: ubiquitous	< 2 minutes	I				m/h	H	H	H																					
		> 2 min. & < 30 min.	*				*	*	*	*																					
		> 30 min.	*	L	I	I	*	*	*	*	Hc		Lc	Lc			Mc	Mc	Mc												
	Nationwide: non-ubiquitous	< 2 minutes	I				m/h	H	H	H	H		L	L			M	M	M												
		> 2 min. & < 30 min.	*				*	*	*	*	*		*	*			*	*	*												
		> 30 min.	*	L	I	I	*	*	*	*	*		*	*	Lc	Mc	*	*	*	Lc	Lc	Mc		lc		lc					
	Urban / Pockets of Coverage	< 2 minutes	I				m/h	H	H	H	H		L	L	L	M	M	M	M	L	L	M		I		I					
		> 2 min. & < 30 min.	*				*	*	*	*	*		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*				
		> 30 min.	*	L	I	I	*	*	*	*	*		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*				
POS/ATM temporary and remote locations	Global	< 2 minutes	I				m/h	H																							
		> 2 min. & < 5 min.	*				*	*	Hc	Hc																					
		> 5 min.	*	L	I	I	*	*	Hc	Hc																					
	Nationwide: ubiquitous	< 2 minutes	I				m/h	H	H	H																					
		> 2 min. & < 5 min.	*				*	*	*	*	Hc		Lc	Lc			Mc	Mc	Mc												
		> 5 min.	*	L	I	I	*	*	*	*	*		*	*			*	*	*	Lc	Lc	Mc		lc		lc					
	Nationwide: non-ubiquitous	< 2 minutes	I				m/h	H	H	H	H		L	L			M	M	M												
		> 2 min. & < 5 min.	*				*	*	*	*	*		*	*	Lc	Mc	*	*	*	Lc	Lc	Mc		lc		lc					
		> 5 min.	*	L	I	I	*	*	*	*	*		*	*	Lc	Mc	*	*	*	Lc	Lc	Mc		lc		lc					
	Urban / Pockets of Coverage	< 2 minutes	I				m/h	H	H	H	H		L	L	L	M	M	M	M	L	L	M		I		I					
		> 2 min. & < 5 min.	*				*	*	*	*	*		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*				
		> 5 min.	*	L	I	I	*	*	*	*	*		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*				
World health information delivery	Global	< 2 minutes	I				m/h	H																							
		> 2 min. & < 30 min.	*				*	*																							
		> 30 min.	*	L	I	I	*	*	Hc	Hc																					
	Nationwide: ubiquitous	< 2 minutes	I				m/h	H	H	H																					
		> 2 min. & < 30 min.	*				*	*	*	*																					
		> 30 min.	*	L	I	I	*	*	*	*	Hc		Lc	Lc			Mc	Mc	Mc												
	Nationwide: non-ubiquitous	< 2 minutes	I				m/h	H	H	H	H		L	L			M	M	M												
		> 2 min. & < 30 min.	*				*	*	*	*	*		*	*			*	*	*												
		> 30 min.	*	L	I	I	*	*	*	*	*		*	*	Lc	Mc	*	*	*	Lc	Lc	Mc		lc		lc					
	Urban / Pockets of Coverage	< 2 minutes	I				m/h	H	H	H	H		L	L	L	M	M	M	M	L	L	M		I		I					
		> 2 min. & < 30 min.	*				*	*	*	*	*		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*				
		> 30 min.	*	L	I	I	*	*	*	*	*		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*				